

Thomas O. Spicer, III

*Department of Chemical Engineering, University of Arkansas
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EDUCATION

PhD, Engineering, University of Arkansas, 1985
MS, Chemical Engineering, University of Arkansas, 1983
BS, Chemical Engineering, University of Arkansas, 1981

PROFESSIONAL EXPERIENCE

Department Head, Department of Chemical Engineering, University of Arkansas,
November 2003 to present
Professor, Department of Chemical Engineering, University of Arkansas, 1996 to
present
Consulting Chemical Engineer, clients including American Petroleum Institute, Dow,
Exxon, Mitsubishi Heavy Industries, TNO, U.S. Environmental Protection
Agency, U.S. Department of Justice, U.S. National Oceanic and Atmospheric
Administration, and others, 1985 to present
Interim Department Head, Department of Chemical Engineering, University of
Arkansas, July 2001 to October 2003
Associate Professor, Department of Chemical Engineering, University of Arkansas,
1988-96
Assistant Professor, Department of Chemical Engineering, University of Arkansas,
1984-88

PROFESSIONAL AFFILIATIONS

American Institute of Chemical Engineers
American Society of Engineering Education
Omega Chi Epsilon
National Fire Protection Association
Registered Professional Engineer - Arkansas
Sigma Xi
Tau Beta Pi

SERVICE

American Institute of Chemical Engineers (AIChE) Student Chapter Faculty Co-
Sponsor, 2001 to present
ASEE Midwest Section Bylaws Committee, 1991 to 1992

ASEE Midwest Section Meeting Paper Committee, 1992
 Chemical Engineering Computing Facility and Use Committee, 1988 to 1990
 Chemical Engineering Graduate Studies Committee, 1992 to present
 College of Engineering Academic Ethics Board, 1993-1995 and 1997 to 2002
 College of Engineering Faculty Computer Committee, 2000 to present
 Habitat for Humanity, Site Selection and Building Committees; Board of Directors
 Safety and Chemical Engineering Education (SACHE) of Center for Chemical Process
 Safety (CCPS) of the American Institute of Chemical Engineers (AIChE), 2001
 to present

PROFESSIONAL ACTIVITIES

Refereed Journal Articles

1. Spicer, T.O., and J.A. Havens, "Modeling the Phase I Thorney Island Experiments," *Journal of Hazardous Materials*, June 1985.
2. Havens, J.A., P.J. Schreurs, and T.O. Spicer, "Analysis and Simulation of Thorney Island Trial 34," *Journal of Hazardous Materials*, November 1987.
3. Spicer, T.O., and J.A. Havens, "Field Test Validation of the DEGADIS Model," *Journal of Hazardous Materials*, November 1987.
4. Hanna, S., P. Chatwin, E. Chikhliwala, R. Londergan, T. Spicer, and J. Weil, "Results from the Model Evaluation Panel," *Plant/Operations Progress*, Vol. 11, No.1, January 1992.
5. Havens, J., H. Walker, and T.O. Spicer, "Wind-Tunnel Data Sets for Complex Dispersion Model Evaluation," *Journal of Loss Prevention in the Process Industries*, Vol.7, No.2, 1994.
6. Baik, J.H., H. Walker, T.O. Spicer, and J. Havens, "Measurement of Low Velocities in CO₂/Air Mixtures Using Hot-Wire/Film Anemometry," *Process Safety and Environmental Protection: Transactions of the Institution of Chemical Engineers Part B*, Vol. 74, May 1996.
7. Spicer, T.O., J.H. Baik, and J. Havens, "Molecular Diffusion Effects on Entrainment in Wind Tunnel Studies of Dense Gas Dispersion," *Process Safety and Environmental Protection: Transactions of the Institution of Chemical Engineers Part B*, Vol. 74, August 1996.
8. Spicer, T.O., and J. Havens, "Application of Dispersion Models to Flammable Cloud Analyses," *Journal of Hazardous Materials*, Vol. 49, 1996.
9. Havens, J., H. Walker, and T.O. Spicer, "Wind tunnel study of air entrainment into two-dimensional dense gas plumes at the Chemical Hazards Research Center", *Atmospheric Environment*, Vol. 35, 2001.

Other Journal Publications

1. Havens, J., and T.O. Spicer, "Software Review - TECJET: An Atmospheric Dispersion Model," *Risk Analysis*, Vol. 10, No. 3, 1990.
2. Havens, J., and T. Spicer, "Book Reviews: Estimating the Flammable Mass of a Vapor Cloud," *Process Safety and Environmental Protection: Transactions of the Institution of Chemical Engineers Part B*, Vol. 79, January 2001.
3. Spicer, T., "Letter to the Editor," *Chemical Engineering Education*, Vol. 35(2), Spring 2001.
4. Havens, J., T. Spicer, and K. Perry, "New Models Predict Consequences of LNG Releases," Gas Technology Institute and U.S. Department of Energy Gas TIPS, Fall 2002.

Symposium Proceedings

1. Havens, J.A., and T.O. Spicer, "Further Analysis of Catastrophic LNG Spill Vapor Dispersion," *Heavy Gas and Risk Assessment--II*, S. Hartwig (ed.), 1983.
2. Havens, J.A., and T.O. Spicer, "Gravity Spreading and Air Entrainment by Heavy Gases Instantaneously Released in a Calm Atmosphere," I.U.T.A.M. Symposium on Atmospheric Dispersion of Heavy Gases and Small Particles, Den Haag, The Netherlands, 1983.
3. Spicer, T.O., and J.A. Havens, "Development of a Heavier-than-Air Gas Dispersion Model for the U.S. Coast Guard Hazard Assessment Computer System," *Heavy Gas and Risk Assessment--III*, S. Hartwig (ed.), 1985.
4. Spicer, T.O., and J.A. Havens, "Application of a Heavy Gas Dispersion Model to the Prediction of Dispersion of Nitrogen Tetroxide," JANNAF Safety and Environmental Protection Subcommittee Meeting, Monterey, CA, 1985.
5. Spicer, T.O., J.A. Havens, P.A. Tebeau, and L.E. Key, "DEGADIS--A Heavier-than-Air Gas Atmospheric Dispersion Model Developed for the U.S. Coast Guard," Air Pollution Control Association Annual Meeting, Minneapolis, MN, 1986.
6. Spicer, T.O., and J.A. Havens, "Gravity Flow and Entrainment by Dense Gases Released Instantaneously into Calm Air," Third International Symposium on Stratified Flows, Pasadena, CA, 1987.
7. Spicer, T.O., J.A. Havens, and L.E. Key, "Evaluation of the DEGADIS Dispersion Model Using Data from Field Releases of Pressurized Ammonia," Air Pollution Control Association Annual Meeting, New York, NY, 1987.
8. Havens, J.A., T.O. Spicer, and P.J. Schreurs, "Evaluation of 3- Dimensional Numerical Atmospheric Dispersion Models," International Conference on Vapor Cloud Modeling, Boston, MA, 1987.
9. Havens, J.A., T.O. Spicer, and D.E. Layland, "A Dispersion Model for Elevated Heavy Gas Jet Releases," International Conference on Vapor Cloud Modeling, Boston, MA, 1987.
10. Spicer, T.O., J.A. Havens, and L.E. Key, "Extension of DEGADIS for Modeling Aerosol Releases," International Conference on Vapor Cloud Modeling, Boston, MA,

- 1987.
11. Spicer, T.O., J.A. Havens, and L.E. Key, "Uncertainties in the Application of Atmospheric Dispersion Models in the Presence of Jet Releases, Aerosol Releases, or Heterogeneous Surface Roughness," JANNAF Safety and Environmental Protection Subcommittee Meeting, Monterey, CA, 1988.
12. Spicer, T.O., and J. Havens, "Modeling HF and NH₃ Spill Test Data Using DEGADIS," 1988 Summer National Meeting of the American Institute of Chemical Engineers, Denver, CO, 1988.
13. Spicer, T.O., J. Havens, and D. Guinnup, "A Dispersion Model for Gas Pipeline Accidental Releases," 1989 Spring National Meeting, American Institute of Chemical Engineers, April 1989.
14. Havens, J.A., T.O. Spicer, and D. Guinnup, "Extension of the DEGADIS Atmospheric Dispersion Model for Elevated Jet Releases," 6th International Symposium - Loss Prevention and Safety Promotion in the Process Industries, Oslo, Norway, June 1989.
15. Spicer, T.O., and J. Havens, "Modelling Aerosol Dispersion for Accident Consequence Analyses," 1990 American Institute of Chemical Engineers Spring National Meeting, Orlando, FL, 1990.
16. Havens, J., T.O. Spicer, S. Khajehnajafi, and T. Williams, "Developments in Liquefied Natural Gas Dispersion Modeling," International Conference and Workshop on Modeling and Mitigating the Consequences of Accidental Releases of Hazardous Materials, AIChE, New Orleans, LA, May 1991.
17. Touma, J.S., D. Guinnup, and T.O. Spicer, "Development of a Guidance Document for the Application of Refined Dispersion Models for Air Toxics Releases," 85th Annual Meeting of the Air and Waste Management Association, Kansas City, MO, June 1992.
18. Miller, Billy D., and T.O. Spicer, "Spreading And Vaporization of LNG Spills on Land," American Gas Association Distribution Transmission Conference and Exhibit, Orlando, FL, May 1993.
19. Ohba, R., H. Mishima, and T.O. Spicer, "The Calculation of LNG Vapor Dispersion," Japan Society for Aeronautical and Space Sciences (West Branch), Nagasaki, Japan, November 1993.
20. Spicer, T.O., and J. Havens, "Application of Dispersion Models to Flammable Cloud Analyses," 6th Annual Petro-Safe, Houston, February 1995.
21. Havens, J., T.O. Spicer, H. Walker, and T. Williams, "Validation of Mathematical Models for Dense Gas Dispersion in the Presence of Obstacles using Wind-Tunnel Data Sets," 8th International Symposium on Loss Prevention and Safety Promotion in the Process Industries, Antwerp, Belgium, June 1995.
22. Havens, J., T.O. Spicer, H. Walker, and T. Williams, "Regulatory Application of Wind Tunnel Models and Complex Mathematical Models for Simulating Atmospheric Dispersion of LNG Vapor," International Conference and Workshop on Modeling and Mitigating the Consequences of Accidental Releases of Hazardous Materials, New Orleans, September 1995.
23. Havens, J., T.O. Spicer, H. Walker, and S. Wiersma, "The Effects of Structures on Large

- LNG Spills," 1998 Process Plant Safety Symposium, October, 1998.
24. Havens, J.A., and T.O. Spicer, "Improvements in Rational Dispersion Modeling for Consequence Assessment," EUROMECH Colloquium 391, Prague, The Czech Republic, September 1999.
 25. Spicer, T.O., and J.A. Havens, "Description and Analysis of Atmospheric Dispersion Tests Conducted by EPA at the DOE Hazmat Spills Center," International Conference and Workshop on Modeling and Mitigating the Consequences of Accidental Releases of Hazardous Materials, San Francisco, September 1999.
 26. Havens, J.A., and T.O. Spicer, "Improvements in Rational Dispersion Modeling for Consequence Assessment," Mary Kay O'Connor Process Safety Center Symposium, College Station, Texas, October 1999.
 27. Havens, J.A., and T.O. Spicer, "Effects of Roughness and Obstacles on Denser-than-Air Gas Cloud Dispersion," International Workshop on Physical Modelling of Flow and Dispersion Phenomenon, Hamburg, Germany, September 2001.
 28. Spicer, T., and J. A. Havens, "Modeling Aerosol Rainout," Mary Kay O'Connor Process Safety Center – 2001 Process Plant Safety Symposium, College Station, Texas, October 2001.
 29. Havens, J., and T. Spicer, "LNG Shipping Safety and Plant Siting Fundamentals --Post 911 (11 September 2001)," IGT Shipping Symposium, London, England, March 2002.
 30. Spicer, T., and J. A. Havens, "Modeling Aerosol Rainout -- Effect of Droplet Mass Transfer," Mary Kay O'Connor Process Safety Center – 2002 Process Plant Safety Symposium, College Station, Texas, October 2002.
 31. Havens, J., T. Spicer, and W. Sheppard, "Wind tunnel experiments for LNG terminal siting," in "Proceedings of PHYSMOD2003: International Workshop on Physical Modelling of Flow Dispersion Phenomena," G. Manfrida and D. Contini, eds., Firenze University Press, September 2003.
 32. Spicer, T., J. Havens, and D. Johnson, "Modeling the Initial Velocity of Aerosol Jets," Mary Kay O'Connor Process Safety Center – 2003 Process Plant Safety Symposium, College Station, Texas, October 2003.
 33. Havens, J., and T. Spicer, "Regulatory Requirements for Safety Exclusion Zones for United States LNG Import Terminals," IGT Shipping Symposium, London, England, April 2004.
 34. Spicer, T., and J. Havens, "Modeling the Initial Velocity of Aerosol Jets: Initiating a New Experimental Program for Model Verification," Mary Kay O'Connor Process Safety Center – 2004 Process Plant Safety Symposium, College Station, Texas, October 2004.

Research Reports

1. Havens, J.A., and T.O. Spicer, "Analysis of Nitrogen Tetroxide Releases into the Atmosphere--Consideration of Dense Gas Effects," U.S. Coast Guard, Washington, DC, 1983.

2. Havens, J.A., and T.O. Spicer, "Development of an Atmospheric Dispersion Model for Heavier-than-Air Gas Mixtures," U.S. Coast Guard Report No. CG-D-23-85, Washington, DC, 1985.
3. Spicer, T.O., "Mathematical Modeling and Experimental Investigation of Heavier-than-Air Gas Dispersion in the Atmosphere," Doctoral Dissertation, University of Arkansas, Fayetteville, AR, 1985.
4. Spicer, T.O., and J.A. Havens, "Development of Vapor Dispersion Models for Nonneutrally Buoyant Gas Mixtures--Analysis of USAF/N₂O₄ Test Data," USAF Engineering and Services Laboratory, May 1986.
5. Spicer, T.O., "Using Different Time Averaging Periods in DEGADIS," Exxon Education Foundation, July 1987.
6. Havens, J.A., T.O. Spicer, and P.J. Schreurs, "Evaluation of 3-D Hydrodynamic Computer Models for Prediction of LNG Vapor Dispersion in the Atmosphere," Gas Research Institute Report 5083-252-0788, August 1987.
7. Spicer, T.O., and J.A. Havens, "Development of Vapor Dispersion Models for Nonneutrally Buoyant Gas Mixtures--Analysis of USCG/NH₃ Test Data," USAF Engineering and Services Laboratory, October 1988.
8. Havens, J.A., and T.O. Spicer, "A Dispersion Model for Elevated Dense Gas Jet Chemical Releases," Environmental Protection Agency, 1988.
9. Havens, J.A., and T.O. Spicer, "Review of Phosgene Release Mitigation Methodology and Development of a Mathematical Model for Reactive Spray - Curtain Design," Chemical Manufacturer's Assoc., 1988.
10. Spicer, T.O., and J.A. Havens, "Users Guide for the DEGADIS 2.1 Dense Gas Dispersion Model," Environmental Protection Agency, Report EPA-450/4-89-019, 1989.
11. Spicer, T.O., "Implementation of DEGADIS V2.1 on a Personal Computer," American Petroleum Institute, 1990.
12. Havens, J., and T.O. Spicer, "LNG Vapor Dispersion Prediction with the DEGADIS Dense Gas Dispersion Model," Gas Research Institute Report 89/0242, 1990.
13. Havens, J.A., and T. Spicer, "Feasibility Assessment of a Conjunctive Modeling Approach for LNG Vapor Dispersion Prediction," Gas Research Institute Report, 1991.
14. Havens, J.A., and T.O. Spicer, "Evaluation of Wind Tunnel Simulation and Complex Mathematical Simulation of LNG Vapor Dispersion," Gas Research Institute Topical Report, 1992.
15. Havens, J.A., and T.O. Spicer, "Prediction of LNG Vapor Dispersion with the FEM3A Model for Comparison with Mercure Model Predictions," Gas Research Institute Topical Report, 1992.
16. Havens, J., and T.O. Spicer, "A Comparison/Evaluation of DEGADIS and NOAA-DEGADIS," Report to Environmental Protection Agency, 1992.
17. Spicer, T.O., "Application of DEGADIS to Example Chemical Release Scenarios," Report to Environmental Protection Agency, 1992.
18. Spicer, T.O., "Screening Methods for Consequence Analyses: Release Rate and

- Dispersion Estimates for Denser-than-Air Gases and Aerosols," Report to Environmental Protection Agency, 1993.
19. Havens, J., T.O. Spicer, and H. Walker, "Regulatory Application of Wind Tunnel Models and Complex Mathematical Models for Simulating Atmospheric Dispersion of LNG Vapor," Gas Research Institute Topical Report, 1994.
 20. Havens, J., and T.O. Spicer, "LNG Vapor Dispersion Case Analyses for the ENAGAS Company," Gas Research Institute Topical Report, 1994.
 21. Havens, J.A., and T.O. Spicer, "Mathematical Modeling of Water Spray Curtain Mitigation of Accidental Hydrogen Fluoride Releases," Allied Signal Report, 1995.
 22. Havens, J., H. Walker, and T. Spicer, "Characterization of the LGFSTF Wind Tunnel in Preparation for the DOE/EPA Hazardous Chemical Evaporation Rate Experiments," U.S. DOE/EPA Chemical Hazards of Atmospheric Releases Research (CHARR) Program Report, March 1995.
 23. Havens, J., T.O. Spicer, and H. Walker, "Evaluation of Mitigation Methods for Accidental LNG Releases: Volume 1/5--Wind Tunnel Experiments and Mathematical Model Simulations to Study Dispersion of a Vapor Cloud Formed following LNG Spillage into a Diked Area Surrounding a Storage Tank," Topical Report for Gas Research Institute, November 1996.
 24. Havens, J., T.O. Spicer, and H. Walker, "Evaluation of Mitigation Methods for Accidental LNG Releases: Volume 2/5--Wind Tunnel Experiments and Mathematical Model Simulations to Study Heat Transfer from a Flat Surface to a Cold Nitrogen Cloud in a Simulated Atmospheric Boundary Layer," Topical Report for Gas Research Institute, November 1996.
 25. Havens, J., T.O. Spicer, and H. Walker, "Evaluation of Mitigation Methods for Accidental LNG Releases: Volume 3/5--Wind Tunnel Experiments for Mitsubishi Heavy Industries, Ltd.," Topical Report for Gas Research Institute, November 1996.
 26. Havens, J., T.O. Spicer, and H. Walker, "Evaluation of Mitigation Methods for Accidental LNG Releases: Volume 4/5--Wind Tunnel Experiments for Osaka Gas Company," Topical Report for Gas Research Institute, November 1996.
 27. Spicer, T.O., J. Havens, and H. Walker, "Evaluation of Mitigation Methods for Accidental LNG Releases: Volume 5/5--Using FEM3A for LNG Accident Consequence Analysis," Topical Report for Gas Research Institute, February 1997.
 28. Spicer, T., "Atmospheric Dispersion Predictions in Support of the DOE HSC Project Hazards Assessment for the Chlorine Institute Rail Car Transfer Project," U.S. Department of Energy HAZMAT Spill Center, July 2000.
 29. Spicer, T., "Atmospheric Dispersion Predictions in Support of the DOE HSC Project Hazards Assessment for Atomized Releases of Methyl Salicylate and Ammonia," U.S. Department of Energy HAZMAT Spill Center, February 2001.
 30. Spicer, T., "Model for Estimating Fire Hazard during a Terrorist Attack from a LNG Tanker," National Oceanic and Atmospheric Administration, Hazardous Materials Response Division, October 2001.
 31. Spicer, T., "Atmospheric Dispersion Predictions in Support of the DOE HSC Project

Hazards Assessment for Explosive Releases of Phosgene," U.S. Department of Energy HAZMAT Spill Center, May 2002.

Invited Lectures and Presentations

1. Mathematical Modeling and Experimental Investigation of Heavier-than-Air Gas Dispersion in the Atmosphere, Oklahoma State University, Stillwater, OK, April 1985.
2. Dispersion Modeling Workshop, Dow Chemical Company, Freeport, TX, March 1987.
3. Fundamentals of Denser-than-Air Gas Dispersion, EPA Modeling Workshop for Toxic Air Contaminants, Kansas City, Mo, June 1988; San Francisco, CA, October 1988.
4. Model Evaluation Workshop, International Conference and Workshop on Modeling and Mitigating the Consequences of Accidental Releases of Hazardous Materials, New Orleans, May 1991.
5. Application of the DEGADIS Dispersion Model to Accidental Releases of Hazardous Chemicals, Los Angeles City Fire Department, Los Angeles, CA, August 1993.
6. Boiling and Spreading of LNG Pools, Supplemental Gas Committee American Gas Association Roundtable, New Orleans, March 1994.
7. Application of the DEGADIS Dispersion Model to Accidental Releases of Anhydrous Ammonia, Joint Gas Research Institute and Fertilizer Institute Workshop, New Orleans, September 1994.
8. Validation of FEM3A for Dense Gas Dispersion in the Presence of Obstacles Using Wind-Tunnel Data Sets, Japanese National Committee of LNG Safety Study Meeting, Nagasaki, Japan, June 1995.
9. Validation of FEM3A for Dense Gas Dispersion in the Presence of Obstacles Using Wind-Tunnel Data Sets, Mitsubishi Heavy Industries, Ltd., Heat Transfer Laboratory Staff Seminar, Nagasaki, Japan, June 1995.
10. The FEM3A Vapor Dispersion Model, Gas Technology Institute Workshop, University of Arkansas, Fayetteville, AR, February 2003.
11. GTI Workshop on LNG Safety Models: FEM3A, Gas Technology Institute Workshop, Houston, TX, September 2004.
12. Bhopal: A 20 Year Perspective, National Association of Science Writers, 2nd Annual NASW Fall Workshop, Fayetteville, AR, November 2004.

Invited Panelist

1. Fumigant Bystander Exposure Model Review: Probabilistic Exposure and Risk Model for Fumigants (PERFUM) Using Iodomethane as a Case Study, FIFRA Scientific Advisory Panel Meeting, August 2004.
2. Fumigant Bystander Exposure Model Review: The Fumigant Exposure Modeling System (FEMS) Using Metam Sodium as a Case Study, FIFRA Scientific Advisory Panel Meeting, August 2004.
3. Fumigant Bystander Exposure Model Review: Soil Fumigant Exposure Assessment

SYSTEM (SOFEA©)) Using Telone as a Case Study, FIFRA Scientific Advisory Panel Meeting, September 2004.

Presentations

1. Application of a Heavy Gas Dispersion Model to the Prediction of Dispersion of Nitrogen Tetroxide, JANNAF Safety and Environmental Protection Subcommittee Meeting, Monterey, CA, November 1985.
2. DEGADIS--A Heavier-than-Air Gas Atmospheric Dispersion Model Developed for the U.S. Coast Guard, Air Pollution Control Association Annual Meeting, Minneapolis, MN, June 1986.
3. Field Test Validation of the DEGADIS Model, Second Symposium on Heavy Gas Dispersion Trials at Thorney Island, Sheffield, England, September 1986.
4. Gravity Flow and Entrainment by Dense Gases Released Instantaneously into Calm Air, Third International Symposium on Stratified Flows, California Institute of Technology, Pasadena, CA, February 1987.
5. Evaluation of the DEGADIS Dispersion Model Using Data from Field Releases of Pressurized Ammonia, Air Pollution Control Association Annual Meeting, New York, NY, June 1987.
6. Extension of DEGADIS for Modeling Aerosol Releases, International Conference on Vapor Cloud Modeling, Boston, MA, November 1987.
7. Uncertainties in the Application of Atmospheric Dispersion Models in the Presence of Jet Releases, Aerosol Releases, or Heterogeneous Surface Roughness, JANNAF Safety and Environmental Protection Subcommittee Meeting, Monterey, CA, 1988.
8. Modeling HF and NH₃ Spill Test Data Using DEGADIS, 1988 Summer National Meeting of the American Institute of Chemical Engineers, Denver, CO, 1988.
9. A Dispersion Model for Gas Pipeline Accidental Releases, 1989 Spring National Meeting, American Institute of Chemical Engineers, Houston, TX, April 1989.
10. Modeling Aerosol Dispersion for Accident Consequences Analyses, 1990 Spring National Meeting of the American Institute of Chemical Engineers, Orlando, FL, 1990.
11. DEGADIS Dense Gas Dispersion Model, Gas Research Institute Project Advisors Meeting, Fayetteville, AR, 1990.
12. Development of a Guidance Document for the Application of Refined Dispersion Models for Air Toxics Releases, 85th Annual Meeting of the Air and Waste Management Association, Kansas City, MO, June 1992.
13. Spreading and Vaporization of LNG Spills on Land, American Gas Association Distribution Transmission Conference and Exhibit, Orlando, FL, May 1993.
14. Application of Dispersion Models to Flammable Cloud Analyses, 6th Annual Petro-Safe, Houston, TX, February 1995.
15. Description and Analysis of Atmospheric Dispersion Tests Conducted by EPA at the DOE Hazmat Spills Center, International Conference and Workshop on Modeling and Mitigating the Consequences of Accidental Releases of Hazardous Materials, San

Francisco, September 1999.

16. Fundamentals of Atmospheric Dispersion, Safety and Chemical Engineering Education Committee Meeting, Detroit, MI, May 2001.
17. Modeling Aerosol Rainout, Mary Kay O'Connor Process Safety Center – 2001 Process Plant Safety Symposium, College Station, Texas, October 2001.
18. Modeling the Initial Velocity of Aerosol Jets, Mary Kay O'Connor Process Safety Center – 2003 Process Plant Safety Symposium, College Station, Texas, October 2003.
19. Modeling the Initial Velocity of Aerosol Jets: Initiating a New Experimental Program for Model Verification, Mary Kay O'Connor Process Safety Center – 2004 Process Plant Safety Symposium, College Station, Texas, October 2004.

Poster Presentations

1. Spicer, T.O. and J.A. Havens, "Gravity Flow and Entrainment by Dense Gases Released Instantaneously into Calm Air," Third International Symposium on Stratified Flows, Pasadena, CA, 1987.
2. Havens, J., T. O. Spicer, H. Walker, and T. Williams, "LNG Vapor Dispersion Experiments for Complex Mathematical Model Evaluation," LNG-11: 8th International Conference and Exhibition on LNG, 3-6 July 1995, Birmingham, U.K.

Interviews

1. "Mathematical Modeling at the Chemical Hazards Research Center," live television interview on "Breakfast Time," fX network, Fayetteville, AR, March 1995.
2. "Research Info May Help Lower Deaths," Russell Ray, The Morning News, 29 April, 1995.

G437-289

See the response to Comment G437-288.

Exhibit 7

G437-289

December 13, 2004

Lieutenant Ken Kusano
U.S. Coast Guard
2100 Second Street, S.W.
Washington, D.C. 20593-0001

Cy Oggins
California State Lands Commission
100 Howe Ave., Suite 100-South
Sacramento, California 95825-8202

RE: Cabrillo Port Liquefied Natural Gas Deepwater Port – Comments on Draft EIS/R

Dear Lieutenant Kusano and Mr. Oggins,

This letter is sent on behalf of the California Coastal Protection Network. I was asked to perform an independent, objective review of the safety analysis contained in the Draft EIS/EIR for the Cabrillo Port LNG Deepwater Port. The following comments reflect my own independent expert analysis of the safety sections, particularly focusing on the consequence modeling methodologies utilized in the Draft EIS/EIR. Attached to this letter, please find a copy of my curricula vitae.

I have reviewed section 4.2 Public Safety: Hazard and Risk Analysis of the October 2004 Draft EIS/EIR for the Cabrillo Port LNG Deepwater Port project, as listed on the web site http://www.cabrilloport.ene.com/draft_eiseir.htm. In particular, I reviewed pages 4.2-13 to 4.2-29, which cover spills of LNG onto water from the FSRU and its attendant LNG marine tankers. My review considers only the consequence analysis for these spills and is not concerned with any risk analysis.

To its credit, the safety analysis includes a "worst case" scenario (5), in which the entire contents of the FSRU (300,000 cubic meters) is suddenly discharged, in addition to a several single tank releases of 100,000 cubic meters. On the other hand, the detailed analysis of these spill scenarios is questionable, for several reasons.

(1) Some scenarios are defined as "release with subsequent ignition". This appears to be a spill that evaporates to form a vapor cloud that is subsequently ignited after a time and travel distance at which the cloud is still ignitable, and through which a flame could propagate. The possibility that the spill could ignite at the location and time of the spill discharge, forming a pool fire, is not considered. Such pool fires could emit harmful thermal radiation to greater distances than the "release with subsequent ignition" spills.

(2) Although the details of the modeling are missing (an "Independent Risk Assessment report", referred to on page 4.2-16, is not contained in the draft document), it appears to me that the methods used do not meet the standards for consequence analysis that are now used for land side terminals and contained in recent EIS's published by the Federal Energy Regulatory Commission. This includes both the pool fire and vapor dispersion modeling required for assessing the safety hazards of spills from onshore LNG facilities.

Based upon my reading of the Draft EIS/EIR, the consequence analysis is incomplete and technically flawed, and almost certainly underestimates the offshore safety hazard of spills from the proposed FSRU project.

Sincerely yours,

Dr. James Fay

May 1998

JAMES ALAN FAY

Biographical Summary

James A. Fay is Professor Emeritus of Mechanical Engineering and Senior Lecturer at the Massachusetts Institute of Technology. His current field of interest is environmental engineering, and his recent research activities have concentrated on air and water pollution problems, including the dispersion of air pollutants in the atmosphere, acid rain, the safety hazards of liquefied gases, renewable energy (including small scale tidal power) and the spread of oil and other hazardous liquids on the ocean. In previous years he carried out research on combustion and detonation, hypersonic heat transfer, magnetohydrodynamics and plasmadynamics.

Professor Fay served as Chairman of the Massachusetts Port Authority (1972-1977) and as Chairman of the Air Pollution Control Commission of the City of Boston (1969-1972). He has served on twelve boards, committees and panels of the National Research Council, including two terms on the Environmental Studies Board. He is currently a director emeritus of the Union of Concerned Scientists and a former director of the Conservation Law Foundation.

A fellow of the American Academy of Arts and Sciences, the American Physical Society, the American Institute of Aeronautics and Astronautics, and the American Association for the Advancement of Science, Professor Fay is also a member of the National Academy of Engineering and three technical societies. In 1980 he was an Overseas Fellow of Churchill College, Cambridge University, and in 1990 a Fulbright Lecturer in India.

Professor Fay received his B.S. degree from Webb Institute of Naval Architecture in 1944, the M.S. degree from the Massachusetts Institute of Technology in 1947 and the Ph.D. degree from Cornell University in 1951. He was an Assistant Professor in the Department of Engineering Mechanics at Cornell University from 1951 to 1955. Since 1955 he has been a member of the faculty in the Department of Mechanical Engineering at M.I.T.

JAMES ALAN FAY

Biographical Data

Born November 1, 1923 at Southold, NY.

Married Agatha M. Kelly, Jan. 12, 1946

Children David A. (b. 1947), Mark B. (b. 1949), Colin M. (b. 1950), Jamie M. (b. 1953), Peter R. (b. 1955), Michele M. (b. 1959).

Education

B.S. in Naval Architecture and Marine Engineering, Webb Institute of Naval Architecture (1944).

M.S. in Marine Engineering, Massachusetts Institute of Technology (1947).

Ph.D. in Engineering Mechanics, Cornell University (1951)

Professional Experience

Asst. Planning and Estimating Supt., Long Beach Naval Shipyard, Long Beach, CA (1945-46).

Research Engineer, Lima-Hamilton Corp., Hamilton, OH (1947-49).

Assistant Professor, Department of Engineering Mechanics, Cornell University (1951-55).

Associate Professor (1955-60), Professor (1960-89), Professor Emeritus and Senior Lecturer (1989-), Department of Mechanical Engineering, Massachusetts Institute of Technology.

Professional Societies

Fellow, American Academy of Arts and Sciences.

Fellow, American Physical Society.

Fellow, American Institute of Aeronautics and Astronautics.

Fellow, American Association for the Advancement of Science

Member, National Academy of Engineering

Member, American Society of Mechanical Engineers

Member, Sigma XI

Member, Air and Waste Management Association

Professional Activities

Executive Committee, Division of Fluid Dynamics, American Physical Society (1964-67).

Subcommittee on Fluid Mechanics, NASA Research and Technology Advisory Committee on Basic Research (1965-68).
 Chairman, Plasmadynamics Committee, American Institute of Aeronautics and Astronautics (1967-68).
 Chairman, Air Pollution Control Commission, City of Boston (1969-72).
 Environmental Study Group, Environmental Studies Board, National Academy of Sciences (1969-70).

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Chairman, Jamaica Bay Environmental Study Group, National academy of Sciences (1970-71).
 Fluid Dynamics Committee and Atmospheric Environment Committee, American Institute of Aeronautics and Astronautics (1971-74).
 Committee on Motor Vehicle Emissions, National Academy of Sciences (1971-74).
 Chairman, Massachusetts Port Authority (1972-77).
 Executive Committee, Metropolitan Area Planning Council (1972-77).
 Environmental Studies Board, National Research Council (1973-78).
 Maritime Transportation Research Board, National Research Council (1973-74).
 Director, Boston Shipping Association (1973-75).
 Director, Boston Harbor Associates (1974-78).
 New England Energy Policy Council (1975-78).
 Committee on Environmental Decision Making, National Research Council (1975-77).
 National Energy Policy Committee, Sierra Club (1976-78).
 Advisory Committee, Dept. of Aerospace and Mechanical Engineering, Princeton University (1977-81).
 Director, SCA Services, Inc. (1977-84)
 Committee on Radioactive Waste Management, National Research Council (1978-81).
 Director, Union of Concerned Scientists (1978-).
 Committee on Urban Waterfront Lands, National Research Council (1978-79).
 Committee on Environmental Research and Development, National Research Council (1978-79).
 Associate Director, Massachusetts Audubon Society (1978-81).
 Panel on Social and Economic Aspects of Radioactive Waste Management, National Research Council (1980-84).
 Environmental Studies Board, National Research Council (1980-83).
 Panel on Risk Analysis of Marine Transport of Hazardous Material, National Research Council (1981-82).
 Exploratory Committee on the Future of Nuclear Power, National Research Council (1984-85).
 Director, Conservation Law Foundation (1984-94)
 Committee on Risk Assessment and Communication, National Research Council (1987-89).

Honors and Awards

New York State Regents Scholarship (1941-44)

American Bureau of Shipping Prize, Webb Institute of Naval Architecture (1944).
 Stevenson Taylor Memorial Prize, Webb Institute of Naval Architecture (1944).
 Society of Naval Architects and Marine Engineers Scholarship (1946).
 Dupont Fellowship, Cornell University (1949-50).
 Fellow, American Academy of Arts and Sciences (1963).
 Fellow, American Physical Society (1964).
 Fellow, American Institute of Aeronautics and Astronautics (1968).
 Fellow, American Association for the Advancement of Science (1978).
 Overseas Fellow, Churchill College, Cambridge University (1980).
 Fulbright Lecturer, India (1990).
 Member, National Academy of Engineering (1998)

Consulting Experience

American Locomotive Co. (1950-55).
 Midwest Research Institute (1952-54).
 Avco-Everett Research Laboratory (1955-69).
 Executive Dept., State of Maine (1971-72).
 Dept. of Sea and Shore Fisheries, State of Maine (1972).
 Town of East Hartford, CT (1972-74).
 Union of Concerned Scientists (1973-78).
 Dept. of Marine Resources, State of Maine (1975-76).
 Amscan Associates (1975-78).
 Mt. Auburn Research Associates (1975-76).
 Natural Resources Council of Maine (1977-92).
 Massachusetts Energy Facilities Siting Council (1977-83).
 Aberdour and Dalgety Bay Joint Action Group (1978-81)
 Canvey I. Oil Refineries Resistance Group (1979-83).
 Woodbridge Township, NJ (1981-85).
 City of Port Moody, British Columbia (1981-82).
 Conservation Law Foundation (1981-83).
 Town of Weston, MA (1986-89).
 Harvard Institute for International Development (1987-88).

96. James A. Fay, "Thermal fluctuations of electric field and solute density in biological cells," *Physical Review E*, **56**, 3460-3467, 1997.

Exhibit 8



December 15, 2004

To: United States Coast Guard (USCG), the United States Maritime Administration (MARAD), and the California State Lands Commission (CSLC)

Regarding: Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Cabrillo Liquefied Natural Gas (LNG) Deepwater Port (the Project) proposed by BHPB Billiton LNG International, Inc.

I have worked as a marine policy consultant and contractor on a number of CEQA and NEPA documents that focus on marine use, marine conservation, and coastal habitat and open space preservation and enhancement. I also teach graduate and undergraduate courses in ocean and coastal policy at UC Santa Barbara. I am currently the Acting Director of UC Santa Barbara's Ocean and Coastal Policy Center.

This letter focuses on the relevant sections of the BHP Billiton Cabrillo LNG Deepwater Port DEIS/DEIR (hereafter, BHPB DEIS/DEIR) with respect to general impacts and risks of the proposed project on coastal marine ecosystems of the study area, and the potential risks associated with the introduction of non-native marine invasive species from the operation of the proposed project. The major points of this comment letter are:

- The current plan of the Port of Los Angeles/Long Beach is to increase capacity by 100% by the year 2020. This information is not included in the BHPB DEIS/DEIR. Vessel traffic in the project area will be greater than the BHPB DEIS/DEIR identifies and evaluates. The result is that the characterization of this risk and cumulative impacts of the proposed project is inadequate. Additional mitigation measures are needed to address Class I impacts to marine ecosystems from a potential vessel collisions or accidents.
- The BHPB DEIS/DEIR fails to identify and assess the current and future marine resource use and associated multiple-use conflict of the project area. The BHPB will exacerbate existing and future multiple-use conflict of the area. The BHPB DEIS/DEIR should offer mitigation to address these multiple-use and cumulative impacts.
- The BHPB DEIS/DEIR fails to describe the general character of marine ecosystem disturbance in the study area, and therefore inadequately addresses the potential Class I impacts and risks of the proposed project on marine ecosystem health and integrity.
- The management approach adopted in the BHPB DEIS/DEIR focuses on ballast water exchange beyond the EEZ. Scientists show that this management approach cannot prevent the introduction of marine invasive species to coastal marine ecosystems. Scientists show that marine invasive species pose a significant threat

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Sections 4.20.1 and 4.20.3 contain additional information on this topic.

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Section 4.7.4 presents both Applicant measures that are part of the Project and additional mitigation measures deemed necessary to address such impacts from a significant release of hazardous materials as a result of vessel collisions.

G437-292

Sections 4.7.1.4 and 4.20.1 address this topic.

G437-293

Section 4.7.1 describes the existing environmental conditions in the Project area. Section 4.7.4 discusses the potential Project related disturbances to the ecosystem.

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The Project would comply with all regulatory requirements regarding ballast water exchange. Ballast water exchanges would not occur within the Exclusive Economic Zone (EEZ) or at the proposed deepwater port.